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FACTOR ANALYSIS OF LEADERSHIP MEASURES FROM A TRAINING PROGRAM

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MEASURES FROM A TRAINING PROGRAM

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FACTOR ANALYSIS OF LEADERSHIP MEASURES FROM A TRAINING PROGRAM

Recent leadership research has focused upon the interactive influence of the leader and the organizational structure in which he operated (see Jacobs¹ for a review of these efforts), and results have indicated the difficulty of identifying the effective leader without considering the structure. On the other hand, research in the U. S. Army² has established broad behavioral dimensions of leadership in a simulated combat situation. The organizational requirements of the Army make essential the early and continuous identification of leaders who can perform effectively in a variety of situations. Current methods of evaluation depend heavily on job performance ratings, which are subject to a variety of problems. Expanded opportunities do exist in Army training programs for evaluating leadership potential; however, measures currently are used in an unorganized and unsystemized way.

This paper reports an effort to identify the implicit dimensions of leadership being evaluated by the training staff as part of an Army officer training program. This was accomplished by factor analysis of the measures being used by the school staff.

METHOD

SAMPLE

The sample population was 244 newly commissioned officers attending Officer Basic Course for Engineers. Training consisted of a nine-week course, teaching basic technical, managerial, and leadership knowledge and skills. Most officers were reserve 2d lieutenants on active duty only for the training period. They attended classes for approximately 8 hours a day 5 days a week.

→ p. 6

¹ Jacobs, T. O. Leadership and exchange in formal organizations. Alexandria, Virginia: Human Resources Research Organization, 1971.

² Helme, W. H., L. P. Willemin, and F. C. Grafton. Dimensions of leadership in a simulated combat situation. ARI Technical Research Report 1172, 1971.

MEASURES

A variety of evaluative techniques had been developed by the training staff as having the potential for evaluating various aspects of leadership. Measures included both diagnostic and training tests. Eighteen of these measures were selected for this project.

The Officer Evaluation Battery (OEB), developed by the U. S. Army Research Institute, yielded seven measures or scores. Three of these scores were obtained from cognitive (C) knowledge items and four scores from non-cognitive (N-C) attitudinal items. The OEB scores were: Combat Leadership (C) or knowledge of military tactics and practical situations; Combat Leadership (N-C) comprising measures of interest in the outdoors, sports, and aggressive physical activities; Technical-Managerial Leadership (C) or knowledge of scientific, historical, cultural, and political items; Technical-Managerial Leadership (N-C) or interest in mathematics and physical science plus an urban rather than rural background; Career Potential (C) or knowledge of military technology and management; and Career Potential (N-C) representing career officer's response patterns, and interest in physical tasks rather than white collar jobs. Finally, a Career Intention scale was included, composed of overt response on intent to stay in the Army and make it a career.

The 11 measures were obtained from actual training. The Combat Engineer Practical Exam (CEPE) technical (T) score was based on an instructor's evaluation of student performance on a series of combat engineering field problems, and a CEPE leadership (L) score based on evaluation of leadership traits during the CEPE (T) problems. Next was the Combat Operations Exam, a paper-and-pencil test dealing with military operations problems. The Orienteering score was a time-plus-error score received on a cross-country course using a compass and map. There was also a Leadership Exam, a multiple-choice test on leadership concepts. The Horizontal Construction Exam was a paper-and-pencil test on specific engineering concepts. The 8th Week Associate (peer) Nominations were mutual evaluations of leadership potential by platoon members, while the Tactical (TAC) Officer Ratings were evaluations of leadership potential by the supervisory officer. The Engineer Stakes, Technical (T) were instructor evaluations on a series of technical engineering field problems at the end of the course, and the Engineer Stakes, Leadership (L) were instructor evaluations of leadership performance (traits) during the technical stakes. The Oral Presentation (History) was an instructor's evaluation of the student's performance during a presentation on the history of the U. S. Army Corps of Engineers.

ANALYSIS

A principal components factor analysis was done with the highest off-diagonal correlation coefficient used as the communality estimate. A varimax rotation was then done on all factors having an eigen value greater than 1.00. Due to missing data, the correlation coefficients were based on slightly variable N's; the maximum N for each pair of variables was used for the analysis. The smallest N for any correlation was 240 and the largest N was 244. Rotation solutions were also looked at by reducing the number of original factors by one for factor solutions greater than two.

RESULTS

Table 1 gives the intercorrelation matrix for all variables, and Table 2 gives the rotated factor loading for the three factor solution adopted. Only loadings of an absolute value of .25 or greater are reported. The proportions of variance accounted for by the rotated factors are reported at the bottom of Table 2.

Factor I, called "cognitive/verbal leadership skills," has the highest loading on the cognitive portions of the OEB and the training paper-and-pencil tests. Factor II, called "leadership behavioral style," has the highest loadings on the associate nominations, TAC officer ratings, and the non-cognitive portions of the OEB; these measures reflect the manner in which leadership is displayed. Factor III, called "leadership performance," has the highest loading on the CEPE (T) and (L) field problems and the Engineer Stakes (L). The school tests loaded on both Factor I and Factor III; the associate nominations and TAC evaluations loaded on both Factor II and Factor III.

These three factors were closely related to evaluative concepts utilized in training and assessment programs.³ Cognitive/verbal leadership skills was related to academic orientation or general mental abilities. Leadership behavioral style was related to evaluations of characteristics by self, peers, and superiors. Finally, leadership performance was related to applied exercises evaluating performance.

³ Wollowick, H. B. and W. J. McNamara. Relationship of the components of an assessment center to management success. Journal of Applied Psychology, 1969, 53, 348-352.

Table 1
INTERCORRELATION COEFFICIENTS OF ALL VARIABLES

Variable Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. OEB Combat Ldrs (C)	1.00																	
2. CEPE (L)	.15*	1.00																
3. OEB Combat Ldrs (N-C)	.13*	.12	1.00															
4. Combat Operations Exam	.30*	.21*	.01	1.00														
5. Orienteering	.11	.18*	.23*	.04	1.00													
6. OEB Career Potential (N-C)	.25*	-.08	.41*	-.05	.14*	1.00												
7. OEB Tech-Mgr Ldrs (C)	.37*	.12	.02	.25*	-.02	.04	1.00											
8. CEPE (T)	.21*	.74*	.12	.26*	.22*	-.06	.12	1.00										
9. OEB Career Potential (C)	.14*	.08	.11	.16*	.07	.18*	.42*	.10	1.00									
10. OEB Tech-Mgr Ldrs (N-C)	.02	.28*	.29*	.09	.07	.02	.25*	.23*	.22*	1.00								
11. Leadership Exam	.28*	.15*	.05	.50*	.03	-.07	.19*	.25*	.19*	.15*	1.00							
12. Horizontal Construction Exam	.36*	.36*	.04	.38*	.05	-.05	.29*	.44*	.29*	.11	.29*	1.00						
13. 8th Week Associate Nomination	.16*	.29*	.24*	.15*	.22*	.10	-.09	.23*	.01	.13	.23*	.13*	1.00					
14. TAC Officer Rating	.17*	.20*	.27*	.20*	.11	.17*	-.02	.20*	.13*	.23*	.15*	.14*	.59*	1.00				
15. OEB Career Intent	.07	.01	.35*	-.12	.11	.36*	-.10	-.02	.12	.11	-.00	-.17*	.19*	.22*	1.00			
16. Engineer Stakes (T)	.33*	.38*	.14*	.32*	.19*	.06	.20*	.39*	.32*	.16*	.24*	.37*	.19*	.20*	.04	1.00		
17. Engineer Stakes (L)	.16*	.36*	.15*	.21*	.19*	-.05	.02	.34*	.12	.18*	.20*	.22*	.30*	.10	.05	.20*	1.00	
18. Oral Presentation (History)	.19*	.17*	-.02	.25*	-.08	.08	.14*	.11	.12	.16*	.16*	.17*	.09	.18*	.07	.04	.01	1.00

*significant at $P < .05$

Table 2
FACTOR ANALYSIS OF VARIABLES


Variable Name	ROTATED FACTOR LOADINGS ^a		
	I	II	III
OEB Combat Leadership (C)	.67		
CEPE(L)			.78
OEB Combat Leadership (N-C)		.61	
Combat Operations Exam	.51		.31
Orienteering		.26	.25
OEB Career Potential (N-C)		.58	
OEB Technical-Managerial Ldrs (C)	.61		
CEPE (T)			.78
OEB Career Potential (C)	.64		
OEB Technical-Managerial Ldrs (N-C)			.25
Leadership Exam	.43		.29
Horizontal Construction Exam	.52		.39
8th Week Associate Nomination		.47	.49
TAC Officer Rating		.52	.36
OEB Career Intent		.57	
Engineer Stakes (T)	.41		.38
Engineer Stakes (L)			.45
Oral Presentation (History)	.26		
Proportion of Variance	.13	.10	.14

^a Only loadings of absolute value of $\geq .25$ were reported.

A two-factor solution resulted in a drop in the total variance accounted for by the solution, from 37% for three factors down to 28% for two factors, and resulted in the leadership behavioral style factor remaining intact while the cognitive/verbal leadership skills and leadership performance combined into one factor. There were only two variables with moderate loadings on both factors; all other variables loaded substantially on only one factor.

CONCLUSIONS

Several possible difficulties in this analysis should be pointed out. In general the measures used were not evaluated in terms of reliability, and the low level of intercorrelations would suggest that some measures did in fact suffer from rather low reliability. (First-hand observation of some procedures has supported this view.) Only the OEB⁴ and the associate nominations⁵ have reliability estimates (.70's to .90's). Preliminary work with the school had encountered some difficulties in evaluation time available and a generalized tendency for "halo" effects on evaluations. Finally, the constraints imposed by an operational setting precluded a more integrated and systematic approach to the inclusion of leadership measures.

Although this study is preliminary, three broad leadership factors were identified. A two factor solution resulted in loss of variance accounted for. Pending more definitive analysis, these factors were cognitive/verbal leadership skills, leadership behavioral style, and leadership performance. Further research is under way to verify this structure in other similar training programs, to improve the measurement qualities of the variables, and, finally, to study the relationship between the identified factors and performance in a variety of leadership positions. 

⁴ US Army Research Institute for the Behavioral and Social Sciences, Manual for interpreting the Officer Evaluation Battery. Arlington, Virginia, 1973.

⁵ Downey, R. G. Associate evaluations: Nominations vs. ratings. ARI Technical Paper 253, 1974.

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